M. S. ZAROUG* & Koji ITO*: **Notes on the germination of Japanese dodder (*Cuscuta japonica* Choisy)**

M. S. ザルーグ*・伊藤浩司*: ネナシカズラの発芽について

Japanese dodder (*Cuscuta japonica* Choisy), or Nenashikazura in Japanese, is a native, annual, parasitic, flowering plant found all over Japan (Ohwi 1963). The host plants of the dodder based on the herbarium specimens of SAPT (Herbarium of the Faculy of Agriculture, Hokkaido University) are: *Agrimonia pilosa* var. *japonica*, *Artemisia montana*, *Amphicarpaea edgeworthii* var. *trisperma*, *Aralia elata*, *Callicarpa japonica*, *Celastrus orbiculatus*, *Lathyrus palustris* var. *pilosus*, *Solidago virga-aurea* var. *leiocarpa*, and *Vitis ficifolia* var. *lobata*. In 1985 we recorded the following host plants of the dodder on the sand dune vegetation at Monbetsu, Tokoro, Koshimizu and Shari along the Okhotsk coast, Kitami area, NE Hokkaido: *Artemisia japonica*, *A. montana*, *Achillea alpina* var. *ptarmica*, *Adenophora triphylla* var. *japonica*, *Celastrus orbiculatus*, *Chenopodium album*, *Miscanthus sinensis*, *Rubus parvifolius*, *Thermopsis lupinoides*, *Rosa rugosa*, and *Vicia japonica*.

The dodder posesses remarkably hard-coated seeds, which have special manner of germination. For the ready germination a pretreatment is frequently required in order to promote the water absorption capacity of the seed. Hutchison & Ashton (1979) reported that the germination of *Cuscuta campestris* was induced through scarification of the seed using sand papper; and by soaking the seeds in conc. H_2SO_4 solution and then by storing them in a cold condition. Barton (1965) suggested different manners to promote water permeability of the hard-coated seeds. These include: attack of the seeds by soil microorganisms, climatic influences, brush fire and ingestion in the alimentary canals of domestic animals and birds.

In the Japanese dodder, seed dormancy seems to be broken by brush fire. Ito observed an extraordinary flush of the dodder on *Rosa rugosa* community at Yambetsu in the early spring of 1980 when fire burned some areas of the com-

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munity. The phenomenon is very comparable to the prosperity of *Lespedeza bicolor* in E. Hokkaido, or of *Epilobium angustifolium* after frequent fires in Alaska. In the present study on the ecology of the Japanese dodder, we have paid special attention to the germination in relation to the pretreatment of the hard seed coat.

Material and methods Seed collection: seeds were collected from the withered dodder plants on *Rosa rugosa* and *Artemisia montana* on sand dunes at Koshimizu and Tokoro in the spring of 1985. The seeds were stored in glass jars under room temperature.

Germination test: the seeds were placed on moistened filter paper in petridishes, and kept in an incubater under 6 sets of temperature conditions, that is, 5, 10, 15, 20, 25 and 30°C. The seed germination was induced by two treatments: 1) scarification of the hard seed coat using a sharp blade; and 2) submerging the seeds in conc. H_2SO_4 solution for different periods of time, that is, 5, 10, 15, 20, 25 and 30 minutes.

Results and conclusion Differences of germination between the non-treated seeds and pretreated seeds: the non-treated seeds kept in the incubater for two weeks gave 3% germination at 25°C, and this percentage was persistent for the following 16 weeks. The germination percentage of the pretreated seeds was very high, ranging from 70 to 98% in the scarified seeds and from 14 to 98% in the submerged seeds (Tab. 1). In the latter case, the longer period of

Tab. 1. Germination percentage of non-treated seeds and pretreated seeds on the 15th day after the treatment, which incubated at different temperatures.

Temp. °C	Non-treated	Scarified by a blade	Submerged in conc. H_2SO_4 for 5	10	15	20	25	30 min
5	0	70	14	30	77	53	56	58
10	0	99	33	75	98	99	99	83
15	0	98	40	64	99	99	97	98
20	2	98	48	68	98	99	99	98
25	3	98	60	70	98	97	98	86
30	1	94	62	70	98	99	98	98

* The test was carried out by placing 25 seeds/petridish and replicated four times.

submerging was effective and the maximum level of germination was obtained within periods of 25 minutes or longer with a few exceptions.

Temperature required for the seed to germinate: as seen in Tab. 1, temperature required was different under different treatment conditions. In the non-treated seeds, it was likely to require higher than 20°C to germinate. In the pretreated seeds, the mechanical scarification, where at least 70% of the seeds germinated at 5°C, seems to be more effective than the acid submerging treatment. In the latter the combined effect of time of submergence and temperature influenced the seed germination. The highest germination percentages were obtained when the seeds were submerged for 15 to 30 minutes in the H_2SO_4 solution and within the temperature range between 10 to 30°C. The maximum figures of the combined effect were obtained on the 15 th day after treatment.

Different dodder species seem to have different temperature regimes for the germination. Allred (1964) reported: *Cuscuta approximata* germinated at 1.6 to 15°C; *C. indecora* germinated very little below 10°C; and *C. campestris* did not germinate below 10°C. Furuya et al. (1980) stated that *C. pentagona* did not germinate below 10°C but germinated at 15°C. It is unknown whether or not the pretreatment of the dodder seeds is closely related with the break down of dormancy, but it is sure that this kind of pretreatment serves to improve the water absorption capacity of the seed coat. Under the field conditions burning may contribute to the acceleration of the seed germination and the break down of dormancy as suggested already. Gimingham (1972), however, reported that burning produced 400 to 600°C in *Calluna* canopy for about two minutes when flames passed through the vegetation, but the temperature did not exceed 100°C on the ground surface. This suggests that burning does not damage buried seeds but sometimes helps the break down of dormancy to activate the germination. In fact, Mallik & Gimingham (1985) found that the heated seeds of *Hypericum pulchrum* resulted in high germination percentage at 100°C for two minutes.

Overwintering and germination: overwintering is not always effective on germination. However, we found an interesting phenomenon in the field; among dodder seeds overwintering on the host plant *Rosa rugosa* led some of the seeds to germinate while still within the capsule. Seeds collected from those capsules showed 98% viability but gave only 2% germination during the first week at

25°C when tested. They kept the same tendency for 16 consecutive weeks. A similar observation was made on *C. nevadensis* by Yunker (1942) and considered as rare phenomenon. This suggests that some seeds of dodder seem to lose impermeability because of climatic influences.

This report is only an introduction of our work on the ecology of *C. japonica* Choisy. We obtained some interesting data from laboratory experiments and field observations, which are summarized as follow: 1) the germination of Japanese dodder (*C. japonica* Choisy) was accelerated by the pretreatment of the seeds through scarification of the seed coat by using a sharp blade, and by submerging the seeds in conc. H_2SO_4 solution for several minutes; 2) the optimal temperature for germination is between 10 to 30°C; and 3) germination of *C. japonica* seems to be promoted by purely climatic conditions, the case where a few seeds were found to germinate within the capsule hanging on the host plant; and by brush fire as observed in the field.

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ネナシカズラの発芽についての1985年一年間のテスト結果をまとめてみるといくつか興味あることがわかった。発芽促進のためには厚い果皮を鋭利な刃物で削いた後，濃硫酸に種子を数分から約30分浸したりするとよい。発芽温度は外国からの報告に比べると

意外に幅広く，発芽率を問わなければ，テストした範囲では5°から30°Cにわたっていた。酸に浸した種子の場合，温度10°Cから30°C，浸漬時間15から30分の組み合わせの範囲で発芽成績がよかった。このような前処理を施して発芽が促進される一方，野外では前年の残存蒴果の中で自然発芽する種子も観察された。

○ツルツゲについて（山崎　敬）Takasi YAMAZAKI: On *Ilex rugosa* Fr. Schm.

ツルツゲの葉形は地方によって一定の変異がある。北海道，南千島，サハリンのものは葉が大きくて幅が広く，長楕円形～楕円形，長さ2.5-4 cm，幅1-2 cmである。アポイ山から書かれたマルバツルツゲ var. *vegata* Haraは葉が大きくて幅が広いけれど，特にまるいこともなく，北海道全体のものに通じる性質である。東北地方から中部地方のものは葉が長楕円形～狭長楕円形，長さ1.5-4 cm，幅0.5-1.3 cmと北海道のものに比べると小形である。中部地方南部，近畿地方南部，四国では葉が細長く，狭披針形で長さ2.5-5 cm，幅0.3-0.7 cmである。これをホソバツルツゲという。葉の細い形は中部地方北部から東北地方南部にもときにみられ，ツルツゲとの間に中間形もあるが大体分布域を異にする。

ツルツゲは生育環境のきびしい場所にはえているので，葉形に変異が多く北海道でも本州のツルツゲに似た形もでてくる。マルバツルツゲが書かれたアポイ山でも総べてが葉の大きいものばかりでなく，小さい個体もでてくるが，これは生育場所によるものと思われる。全体的にみると，北海道，南千島，サハリンのものは大形なので，本州のものから区別して**エゾツルツゲ**と名付ける。ホソバツルツゲを変種として区別する場合には，北海道と本州の間の差異も変種関係として区別する必要がある。学名はサハリンが基準であるから，エゾツルツゲが基準で，本州のツルツゲはその変種になる。

Ilex rugosa Fr. Schm. var. **hondoensis** Yamazaki, var. nov.

Folia anguste oblonga vel oblonga, 1.5-4 cm longa, 0.5-1.3 cm lata.

Typus. Pref. Tochigi, Nikko, Mt. Nantai, in conifer forest of eastern slope at 1300-1600 m (Fusako Yamazaki, Sept. 15, 1965, no. 9834, TI).

Distr. Central and northern Honsyu in Japan.

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